INFLUENZAL PNEUMONIA:
THE INTRAVENOUS INJECTION OF HYDROGEN PEROXIDE.

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IN view of the possibility of a further outbreak of influenza accompanied by broncho-pneumonia, another method of combating the extreme toxæmia and anoxæmia appears to be worthy of record, more particularly so as the clinical importance of the latter has recently been discussed by Professor J. S. Haldane.[1] It is noteworthy that in his paper he lays especial emphasis on the primary need of oxygen *in solution* in the blood.

Theory Underlying the Treatment.

There occurred in Busrah in June and July, 1919, a severe epidemic of influenza, most marked among Indian troops, and accompanied in many cases by an exceedingly toxæmic and fatal broncho-pneumonia. It is unfortunately impossible to give statistics of the mortality of the epidemic, but its extent may be gauged from the fact that in one large Indian hospital in which the influenza cases were segregated in special huts the death-rate was over 80 per cent. in the pneumonia cases with toxic symptoms.

So useless were the usual remedies tried in this latter class of case that we felt justified in giving a trial to any method which held out a prospect of success. It had been observed by one of us (T. H. O.) some years previously that an ammoniacal solution of hydrogen peroxide had, in the presence of a catalyst (copper), a remarkable oxidising power on morphia.[2] Further investigation, as yet unpublished, showed that many other substances were similarly oxidised by this solution, the power of which appeared to depend primarily on the formation of nascent oxygen.

We thought that use might be made of this reaction if the H_2O_2 were given intravenously, in this instance employing the well-known catalytic powers of hæmoglobin as a substitute for the copper, and we hoped thereby, not only to supply oxygen to the tissues with greater rapidity than by the ordinary methods, but also to render the circulating toxins inert by oxidation. The obvious danger was gas-embolism, against which most text-books warn those using H_2O_2 even to wash out serous cavities. We believed, however, in the first place, that pure oxygen, if given sufficiently slowly, would be absorbed before any embolic symptoms developed, and secondly, that the air-embolism known to surgery is really a misnomer for nitrogen embolism.

Effect on Patients.

The first case was an Indian with broncho-pneumonia of influenzal origin and intensely toxæmic. He had been delirious for two days previously, and was selected as being the worst case in the ward and to all appearances moribund. Two ounces of a ten-volume solution of H_2O_2 were diluted with 8 ounces of normal saline, and the solution made slightly alkaline with 5 minims of liquor ammoniæ. This produced a faintly effervescing solution. The median cephalic vein was exposed by open dissection, and the solution infused through a glass cannula attached to a Rogers cholera apparatus.

The solution was infused very slowly, a complete stop being made for half a minute in every four. Small bubbles were allowed to enter the vein unchecked, but if a large accumulation of oxygen appeared in the cannula the transfusion was checked for about a minute until it had gradually entered the vein. The whole transfusion lasted for 15 minutes. The patient showed no signs of discomfort until towards the end of the operation, when he became slightly restless. This, however, passed off in a few minutes, and there were no other untoward symptoms except a moderate rigor which occurred two hours later. After the rigor the temperature, which had been 101·8°, fell to normal and remained so for 36 hours, when it again rose to 101°. The latter rise was not accompanied by toxic symptoms and the temperature gradually fell to normal in the course of the next ten days. The change in the mental condition was remarkable, the patient, who previously had had to be tied in bed owing to delirium, was within six hours of the injection sitting up and asking for food; he slept well the next night and from that time improved in every way, eventually being invalided to India as a walking case three weeks later.

Encouraged by the apparent success in this case, we tried the method on 24 others—cases of influenzal pneumonia—selecting always those whose condition was apparently hopeless. Of the total of 25 cases, 13 recovered and 12 died, a mortality of 48 per cent. Of the 12 who died, 9 showed no visible effect for either good or ill. In 3 there was a temporary improvement. One case only died within five hours of the infusion, during a rigor. One of the cases had four injections at intervals of three to five days without any sign of gas embolism, nor did we find any signs of such embolism post mortem. Of the 13 who recovered, 10 were delirious at the time of infusion and had to be held down in bed. Three were comatose from toxæmia.

The average respiration-rate before the operation was 46 per minute, the greatest being 60 and the least 28. Within 24 hours of the infusion the average rate was 31·5, the greatest fall being from 60 to 24. The noticeable feature, however, was a steadying and deepening of the respiration and a great lessening of the discomfort. The average pulse-rate before infusion was 118. 24 hours later the average was 98.

The temperature in this epidemic was, apart from complications such as malaria or effect of heat, rarely high and usually 101°–103°. In all cases but one the injection was followed by a rigor, after which (except in two of the cases) the temperature fell to normal. Of the two exceptions one remained with the same temperature as before, the other fell from 102° to 100°. The afebrile period lasted usually for 18–36 hours, after which the temperature again rose to 99°–101°, and fell by lysis in 4–7 days.

At this juncture we would point out that the occurrence of a rigor or a fall by crisis is exceeding rare in Mesopotamia in cases of pneumonia. Neither of us remember such an occurrence in an experience of 3½ years among British and Indian troops. As regards the toxæmia, we believe that the frequent occurrence of a rigor and a complete or partial crisis, combined with a rapid improvement in the patient's general and mental condition, indicated that this was overcome in many instances. Whether this was by merely supplying oxygen to devitalised tissues, or whether direct oxidation of the circulating toxins took place, it is not easy to say. It is difficult to believe, however, that so small a quantity of oxygen as is contained in

[1] Brit. Med. Jour., July 19th, 1919.
[2] Medical Chronicle, July, 1914.

Charts of Four Cases in which Hydrogen Peroxide was given Intravenously.

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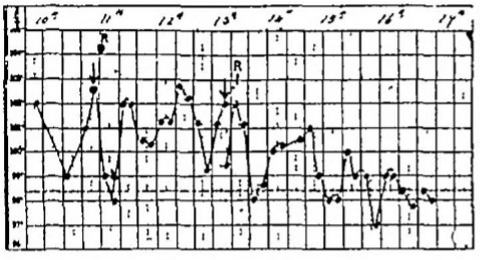

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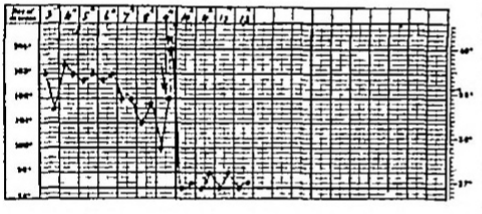

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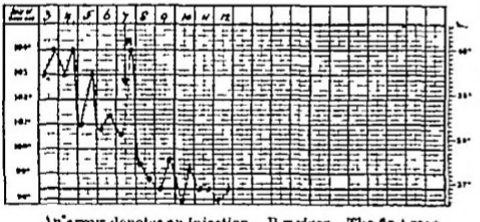

An arrow denotes an injection R = rigor The first case ended fatally, the others recovered

2 oz. of H_2O_2 could produce these effects other than by its nascent oxygen, and this view is supported by a trial we made in a case of toxæmia arising from suppurating inguinal glands in which there was no question of anoxæmia. Here the general improvement which so rapidly took place could only be ascribed to direct oxidation.

The accompanying four charts will give some idea of the reactions obtained in one fatal and three recoveries; in the first it will be seen that four injections were given, the first two of which produced a rigor and temporary improvement. In the second two injections were given, each producing a rigor and some improvement both in pulse and respiration rate. In the third and fourth the injection was followed almost immediately by a rigor and subsequently by a crisis. In all these cases there was marked slowing of the respiration rate after the injection.

Technique.

A strength of 2 oz. H_2O_2 in 8 oz. of normal saline was usually used. In one case 3 oz. H_2O_2 was used without any ill effect. Fifteen minutes was allowed for transfusion and this was checked temporarily every four minutes, or whenever large bubbles of oxygen appeared in the cannula, or if the patient became at all restless. Small bubbles entering the vein did not appear to do any harm. In one case the patient struggled so violently in his delirium that the cannula slipped out and the distal ligature came off. On pressing the vein above two distinct streams could be seen to issue from the wound, the one above bright red and frothing, the other deep blue.

The epidemic ceased almost as suddenly as it had begun, so we were unable to try the method on earlier cases or to give a more extensive trial to repeated injections.

Conclusions

From our experience we conclude that—

1. H_2O_2 can be given intravenously without gas embolism being produced.
2. The anoxæmia is often markedly benefited.
3. The toxæmia appears to be overcome in many cases.
4. The mortality (48 per cent.) compares very favourably with the 80 per cent. in similar cases not so treated, and more so when it is remembered that we only treated the most severe and apparently hopeless.

ANÆSTHESIA IN THROAT AND NOSE OPERATIONS[1]

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[THE author pointed out that operations upon the ear, nose, and throat are not generally serious in themselves, and that it is, therefore, of primary importance that the technique employed should be as free from risk as possible. After dwelling on the risks of chloroform and mixtures containing it and the comparative safety of ether, Mr Rood advanced the following arguments in support of his contention that "ether is the proper anæsthetic for operations upon the nose and throat."]

The Degrees of Anæsthesia.

It will be necessary to speak of two degrees of anæsthesia—deep and light. I should like to define what I mean by this. In deep anæsthesia the respiration is regular, automatic, and shallow, the larynx and pharynx are absolutely paralysed and immobile and respond in no way to stimuli, the recurrent laryngeal nerve is paralysed and the cords stand in wide abduction. The pupil is generally dilated and does not react to light. All reflex activity of the pharynx and larynx is abolished, a Brunings tube can be passed into the larynx, and there is no interference with the quiet rhythm of respiration and no spasm of the cords. The patient in this condition can take no active part in his own operation, he cannot cough. On the other hand, he cannot obstruct his own respiration by laryngeal spasm. If this degree of anæsthesia is induced with ether the patient is pink and rosy, with a full regular pulse of about 80-91.

By light anæsthesia I do not, of course, mean a struggling patient. There is general muscular relaxation, the respiration is regular, but certain

[1] Abridged from a paper read before the joint sections of Anæsthetics and Laryngology of the Royal Society of Medicine on Feb. 6th.